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ABSTRACT

This paper reviews some of the key issues of what should be the cornerstone of a project-based learning approach with information and communication technology (ICT) and net-based multimedia learning resources. It refers to the LAVA Learning project where pedagogic, learning resources and computer-based tools have been developed to support a complete learning environment. The project ended up creating a new project tool for this approach, and learning material and specialized content were made available to users of this tool. Content of all media types was provided a primary focus on text and video material. Curriculum from different content providers was linked together to constitute a source of learning materials. (Author)

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Designing tools and contents for project based learning with net-based curriculum

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Abstract: This paper reviews some of the key issues of what we believe should be the corner stone of a project-based learning approach with ICT and net-based multimedia learning resources. It refers to the LAVA Learning project where pedagogic, learning resources and computer-based tools have been developed to support a complete learning environment. The project ended up creating a new project tool for this approach, and learning material and specialized content were made available to users of this tool. Content of all media types was provided a primary focus on text and video material. Curriculum from different content providers was linked together to constitute a source of learning materials.

Introduction

In Norwegian public schools there is a considerable focus on project based learning as it is required by the Norwegian National School plan, L97, see (L97). The schools were also to start using information and communication technology (ICT) in all subjects. At that time the teacher experience was low in both areas, especially ICT. Internet was there, but net-based learning resources lacked and so did broadband networks.

The LAVA[1] Learning research project was launched trying to design a prototype learning suite consisting of what could be the next generation net-based curriculum and the next generation learning technology on the premises of the pedagogy of project based learning. The research team has been given a total funding of nearly 3 million US$ over a three year period to determine critical factors in the nexus of these three areas.

At the start, we found considerable prior work in pedagogy in the literature, some on appropriate content, and a large body of work in technology and tools for ICT use in schools (with links to pedagogy). Much of the work targets mathematics and science. However we didn't find any projects where the three areas of research were conducted synchronously.

Our focus, and the purpose of this paper, is the combined development of pedagogy, net-based curriculum for project work, and computer technology to support this pedagogical approach in the humanities and social sciences at a school level. The objective of the work has been to create a learning environment that stimulates the pupils towards explorative discussions in a given topic. We therefore have chosen to use the physical arena of collaboration that exists in the schools instead of creating a virtual community on the net. We have also decided to let the pupils in groups of 4 share the main computer in the project work to stimulate discussion and cooperative creation of the learning projects.

This paper presents some of the major decisions made and results of the work done in the project LAVA Learning's second field trial (of three). We start with the pedagogical approach to project based learning and its impact on content. We then point out the requirements for suitable ICT tools that we found to be a consequence

[1] LAVA is a Norwegian acronym for "delivery of video over ATM networks", a collection of projects with a technology viewpoint on video. The ATM is left now focusing on learning as one application of high quality video streaming.

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of the approach. Commonly used software tools were evaluated but found to fall short or our requirements leading us to develop our own net-centric multimedia production tool called "Slime".

Project work as a pedagogical approach

As already indicated the pedagogic focus in Norwegian schools has turned towards more use of project-based learning and use of ICT in all subjects. As discussed by Roschelle et.al. in (Roshelle 00), learning is a complex task. Pedagogic approaches, curriculum and its use, the teacher's experience, the social and physical environment and several other factors affect how children learn. Changing one factor, like infusing PC's into the classroom, will not by itself dramatically change learning. Getting the most from the use of computers should also involve changes in the rest of the learning environment, especially the teaching methods used and the curriculum. In the endeavor to improve learning conditions, one should also pay attention to results from recent cognitive research, for instance in (Bransford 99). It has been shown that the four fundamental characteristics—active engagement, participation in groups, frequent interaction and feedback, and connections to real-world contexts enhances the learning processes significantly.

In project work learning takes place during the creative process of producing a project report and during the discussions among the pupils when they are engaged in doing so. The pupils formulate a problem statement to be investigated, and find and compile information that can be used to elaborate and answer the principle questions raised by the topic of concern. Learning facts and relations between concepts takes place as the pupils pose questions, confirm or reject each other's suggestions and explain their position. The teacher, the content available to the students, and the tools used to compile and document students' efforts, must all contribute to keeping the right focus on the pupil's discussions. When focus is lost, learning will be less effective and subsidiary or irrelevant threads evolve.

The pedagogical researchers involved in LAVA Learning have been pro-active in designing a learning scenario that incorporates the use of net-based curriculum and computer based project tools in a natural way. The scenario based upon was the following:

1. Go through the start page designed by the project (see below) and follow all linked material that you find interesting.
2. Discuss the subjects of the start page and decide upon a main problem to be investigated (had to be accepted by the teacher).
3. Brainstorm the actual subject identifying possible sources of information.
4. Iteratively build an electronic project report using a combination of net-based and self-produced content.
5. Finalize the project as a class presentation.
6. Present the project to the teacher and the rest of the pupils in the class.

To give the pupils a good start of the project, we have had numerous discussions of how the start page should be, and which role it should play. It ended with a web-site providing an introductory preamble to the theme of the project with some provoking elements like "why don't Norwegians eat dogs?"

Figure 1 shows the start page of 2001. Each of the pictures in the collage is a link and leads to a short video, audio file or text. Links are provided at the bottom of the screen to material prepared by content

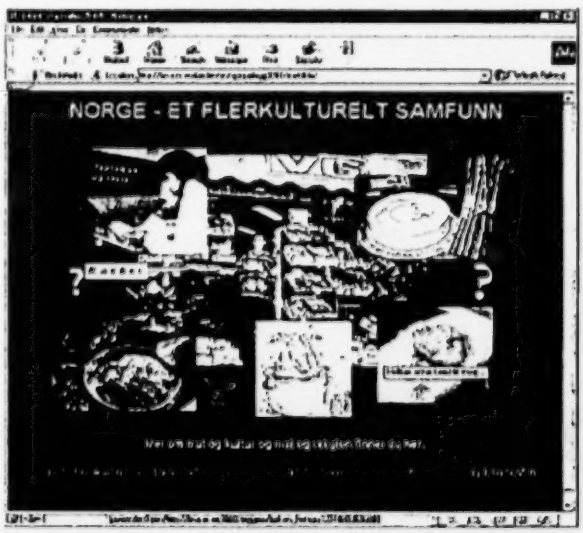

Figure 1: The start page of the project work can be seen at http://lava.nr.no/undervisningsopplegg2001/startside/

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providers participating in the project (described in the next section).

Net-based content

Pupils normally define the problem areas of their work in groups, not necessarily focused on traditional subject boundaries. We observed that they (11 – 15 years) often had problems finding good and relevant content. Their sources were often very ad-hoc, and much of what exists is in English and often written for adults, see (Ludvigsen 01). It also appears to us that the material often supports the pupils' problem areas very poorly. We found a need for more material that is more available to the pupils in language, in actual themes and so on., without being a study book on the net.

Norwegian schools are using the Internet intensively in project work. They combine this with printed materials like study books, lexical books etc. Printed materials are usually very fact oriented and often appear to give answers to all relevant questions. Our opinion is that existing syllabus books often discourages rather than encourages discussion among the students and close subjects.

The Internet on the other hand is completely open. Here you find lots of mainly textual material, but the relevance, organization and language is often in a form not suited for children and project work. There are some exceptions, but in the amount of relevant material in Norwegian was found to be limited.

We therefore asked our content providers to try to develop the next generation net-based curriculum as open learning sources but well coordinated and targeted on "Norway as a multi cultural society" with main focus on food and culture – food and religion. The material was developed according to the following guidelines:

- We would have rich media content — text, pictures, audio, video and web pages.
- The content should be directed towards stimulate curiosity and discussion and not an accumulation of facts.
- Texts should be concise, structured to appeal to intuition, and should not follow a book like structure.
- Content from each of the three content providers (The National Library in Norway, The Norwegian Broadcasting Corporation and Aschehoug, a large Norwegian publisher) should be structured to support the materials provided by the others within the selected subject and should be mutually linked.
- All content should be available in a web-browser.
- In addition to the content providers services, audio, video and pictures should be available for editing and manipulation by the students.

Project tools

In project work, the pupils are producers. Learning takes place as an integrated and iterative process of a number of tasks; Searching (Internet, books aso.), collecting, editing, creating and merging. This normally requires several computer tools to support the students' various work processes.

In the first field trial (of three) in LAVA Learning see (Ludvigsen 01), we used a tool called Syncrolink, see (Syncrolink), in combination with the MS Frontpage html editor and MS Internet Explorer. Syncrolink is a tool that allows the user to annotate videos with hyperlinks to web pages. In the trials, the pupils used Syncrolink to see the video, remove the parts they didn't think was relevant and add links to web pages they had created or that was found on the Internet. Their work process evolved to: Find the interesting places to put links in the video (using Syncrolink), create or find web-pages that cover the issues being discussed (using Internet Explorer or FrontPage), store these web-pages and finally connect the links using Syncrolink.

The problem with this mode of work appeared to be that the students lost track of their contexts and hence that the different parts of what they produced did not harmonize very well.

Another problem that was observed in this first trial was that the children lacked a placeholder for interesting material they came across on the Internet. Adding the URL's to the Favorites list in the browser only solved the problem on a specific machine. In cases where the pupils used different computers for content collection, they had problems transferring correct URL's. Solving the problem involved writing down the URL or using a third tool to type it in, and store this on a networked disk.

In studying the pupil's work we were convinced! Tools can never be neutral in this context. Inappropriate tools will easily distract the pupils' attention. Our opinion is that supporting a good working process is the best way the tool can contribute to good learning processes.

As for MS Frontpage, results (we took lots of video of the pupils during the project work) show that the pupils spent lots of time discussing the appearance of their web pages rather than discussing the content and subject matter.

In collecting preferable properties for a project tool we also wanted the ability to handle all media types in a transparent manner being it net-based or locally produced. Within the actual subject of the pupils project work, the Norwegian Broadcasting Corporation and the National Library had lots of relevant video material that they wanted to make available over the Internet. They wanted to experiment with new net-based services targeted for schools. TV is quite a different medium from video on the web, and TV programs are self-contained and have a longer duration than acceptable as part of a multimedia presentation. We needed to provide mechanisms for the children to include only those parts of the video that were relevant to their field of inquiry.

Experience from early trials of the LAVA project, showed that when students edited a selected video from 30 to about 5 minutes, the exercise gave them a much deeper grasp of the subject matter in the video. In later trials we wanted to preserve this ability.

Permissions to do this editing of copyrighted material were needed and given by the content owners. We wanted to test our earlier observations that the editing process led to better understanding of the video content. To avoid copying and changing the original video material, and avoiding having to copy and handle large video files, the video editing needed to be carried out on streamed video with caching capabilities.

We started looking for a convenient project tool with a clear focus on the need for support of the pupils work processes. Having evaluated easily available tools like MS PowerPoint with MS Media, Macromedia Dreamweaver, Real and others, we found that none provided good support for our requirements. Having the resources of developing our own tool, we decided to create what became the Slime tool shown in figure 2 and 3.

The main approach behind Slime was to provide a set of canvases or *scenes* where all media types could be collected and edited. Since the scenes needed to handle both static and time-varying media types, we decided to tag all media types with time tags. This meant that in playback mode, a text, a web-page and a picture would all be assigned a time slot when each object was displayed on the canvas, and a time where it each object would disappear.

In Slime content objects are displayed in parallel or in sequence or overlapping in time during playback of edited material. The contents of a "scene" can be played as a synchronized whole. When all media objects in a scene have been played, the tool jumps to the next "scene".

To navigate between the scenes of a project, users can use both the *scene graph*, the navigation box to the lower left, and the overall timeline shown on top of the tool. The scene graph is a graphical display of the object names and structure of scenes.

Students can easily switch the search modus of the tool by clicking on the switch button. The search mode allows the user to search the Internet using a standard web-browser, or collect local files or search in given content providers' databases for annotated material. Interesting materials found can be collected and included in a given scene. Material collated in this fashion can be thereafter edited and synchronized with the other content objects.

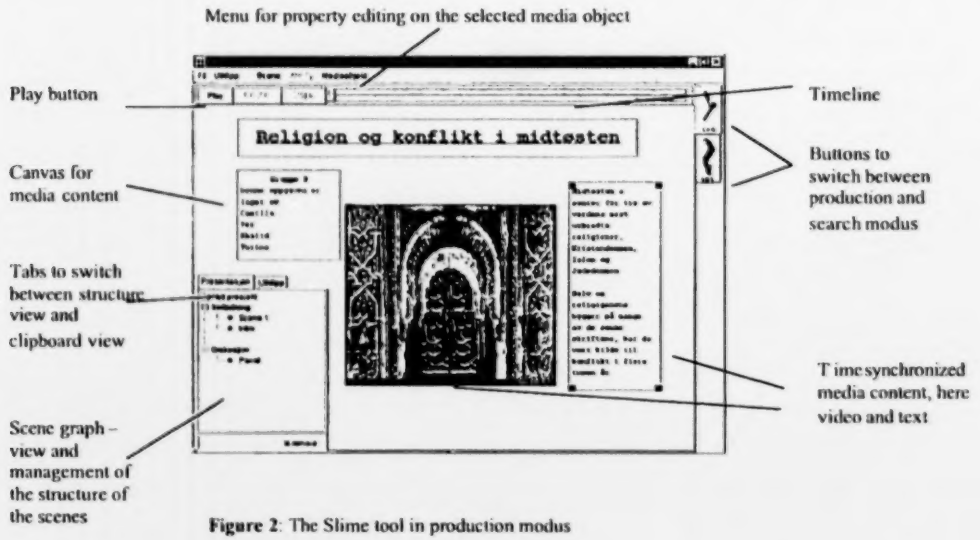
Menu for property editing on the selected media object
Play button
Timeline
Religion og konflikt i midtøsten
Canvas for media content
Buttons to switch between production and search modus
Tabs to switch between structure view and clipboard view
Time synchronized media content, here video and text
Scene graph – view and management of the structure of the scenes

Figure 2: The Slime tool in production modus

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A special object model underlying the Slime tool that makes it possible for content providers to control content distribution and use after it has left the server. These security, IPR and copyright issues are beyond the scope of this paper, but are documented in (Diesen 00).

The snapshots in figures 2 and 3 indicate some of the functionality of the Slime tool. For a more detailed description, please see (Slime).

Results and discussion

To document the school trials, researchers have been in the classrooms, and about 40 hours of video of pupils working together using the Slime tool are available. The pedagogic results will be comprehensively documented in papers by other researchers in the LAVA Learning project, and will be available on http://www.nr.no/lava/lava-lc/ as they are published. We will focus here on some of the content and tool issues.

We found that the Slime tool was able to support the entire project oriented learning process of the pupils. Many of the pupils started their production by creating a structure of empty scenes. This worked as a way of storing their common understanding of what their project would result in. Project structure was frequently revisited and discussed during the project work. This showed us that this kind of mutable structuring element provided good work support. It generated considerable discussion about the organization of their material for example by serving as a focal point to identify what was lacking and so on.

Despite the excellent support of student work-processes, we clearly saw that Slime is a poorer presentation tool than PowerPoint. We had observed problems with timing of the display of text boxes. This indicates the need for a "proceed" button or a revision in our approach to the time model.

What we also found was that material made available directly into the project tool worked well and was used to some extent, but the video material not was sufficiently annotated. The pupils had to go through what they assumed to be relevant in order to evaluate it, and the annotations did not give a sufficiently accurate description of video content. Lots of pupils ended up omitting the use of video, or just using privately produced video. In the next field trial (the third and last of LAVA Learning), we will have to annotate the videos with a higher granularity. This will ensure that search results will turn up only the relevant parts of a video.

We also observed a problem with content resources in general. The problem focus of the different project groups of students was very broad. Teachers will either have to restrict focus, or huge amounts of content must be made available. Students found lots of material on the Internet on relatively ad hoc web sites, and the content was used relatively uncritically with regard to the sources. It is obvious to us that there is a pressing need for more content, and an educational emphasis in critical evaluation of sources available on the Web is very important

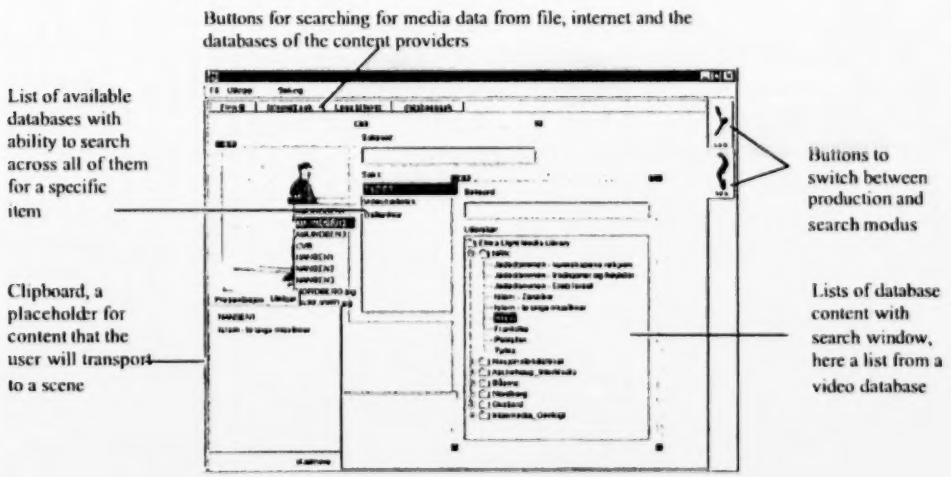
Buttons for searching for media data from file, internet and the databases of the content providers
List of available databases with ability to search across all of them for a specific item
Clipboard, a placeholder for content that the user will transport to a scene
Buttons to switch between production and search modus
Lists of database content with search window, here a list from a video database

Figure 3: The Slime tool in search modus

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Conclusions

We feel that we have managed to combine research in the three areas of pedagogy, content production and technology to create a good working learning environment using a project based learning approach. The main emphasis is on the pedagogy, which defined the framework for a project tool that would support effective learning. The issue was to keep student focus on the subject matter of the project and not on the underlying technology.

Our observations from field studies indicate that a specially designed project tool like Slime enables students to keep their focus on the subject matter to a much greater extent than the traditional off the shelf tools. Integration of search and production facilities turned out to be important to the learning process.

The content providers of LAVA Learning gave access to their raw material, which enabled us to link it directly into the project tool of the pupils. This turned out to be successful, but the amount of available and structured content for educational needs will need to be provided to keep up with demand for electronically available material. It is of great importance to get reliable sources of material available on the Internet for the children working with an approach like project based learning.

Do children learn better in this way? This really is a question with no simple answer. What we have seen is that motivation increases a lot. Some children would hardly leave school. On the other hand, we believe that a good learning result requires well functioning project groups and a good teacher. The teacher needs to help the groups in finding good problems to work with and in testing the relevance and quality of the material they use.

Acknowledgements

LAVA Learning is a project with many contributors from different fields. The learning arena and the Slime software is developed with the combined effort of many school teachers, college teachers, content providers and researchers. We would like to specially acknowledge the contribution from second professor Sten Ludvigsen from InterMedia, University of Oslo, who has lead the pedagogical research and helped us extensively. The same is the case for the researchers Dag Diesen and Asbjørn Oskal from NORUT-IT in Tromsø, Norway, who have been developing Slime with us, and Ph.D. student Anders Kluge at the University of Oslo. Without you, this project wouldn't have been possible. Our thanks also go to the Norwegian Research Council (NFR) that provided funding for the project.

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